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Forestry Canada - Maritimes Region

TECHNICAL NOTE

ENERGY CONSERVATION IN GREENHOUSES VI. WALL AND PIPE INSULATION

NURSERIES

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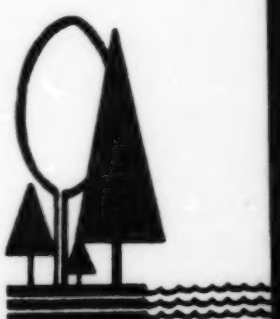

INTRODUCTION

Given rising heating costs, the expense of installing or retrofitting insulation on greenhouse side- and endwalls, or on the hot water supply lines used for heating, is increasingly justified. However, it is important to choose the right type and amount of insulation. Not all types are suitable for use in a greenhouse environment.

SIDE- AND ENDWALLS

Depending on what proportion of the total surface area of the greenhouse is represented by the wall area, significant savings can be realized by installing insulation. Insulating 10 000 m^2 of freestanding, quonset-style greenhouses will yield greater fuel savings than insulating walls of a similar size in a ridge-and-furrow complex, simply because the walls represent less of the total surface area in a gutter-connected structure. In a standard 29 m x 9 m quonset structure, total wall area is about 28% of the total area. The plywood facing on uninsulated walls is rated at R 1.7, slightly higher than a double poly cover. Heat loss through an uninsulated wall will account for about 19% of fuel consumption. A simple calculation shows that, by insulating the walls to R 10-12, energy loss will diminish to one-sixth of the uninsulated value. For a Maritime greenhouse, using 19 000 litres of heating oil annually, the savings would amount to about 3 000 litres each year.

The high humidity levels maintained in a greenhouse make proper selection and installation of the insulation imperative. Unless a moisture-resistant insulation or a tight, carefully applied vapour barrier is used, the insulation's thermal resistance will degrade and may even result in physical breakdown (in batt-type material only).

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The only types of insulation suggested for use within a greenhouse are: EPS type 1 (beadboard) with a vapour barrier and EPS type 4 ("SM" board), which is rated as a vapour barrier and, therefore, does not require one. EPS type 2 (high density beadboard) is also useable, but there is some controversy about thermal degradation under freezing conditions, when ice dams may form within the body of the insulation; thus, at 90-100% interior relative humidity, it too may require a vapour barrier. The same rules for installing a vapour barrier apply as in residential housing: all seams should be caulked to minimize moisture penetration into the insulation; the vapour barrier should be covered to prevent subsequent tears and punctures, and; adequate ventilation must be provided through the outside wall to allow trapped moisture to escape: vent holes should be drilled in moisture-proof exteriors (e.g. FRP sheeting).

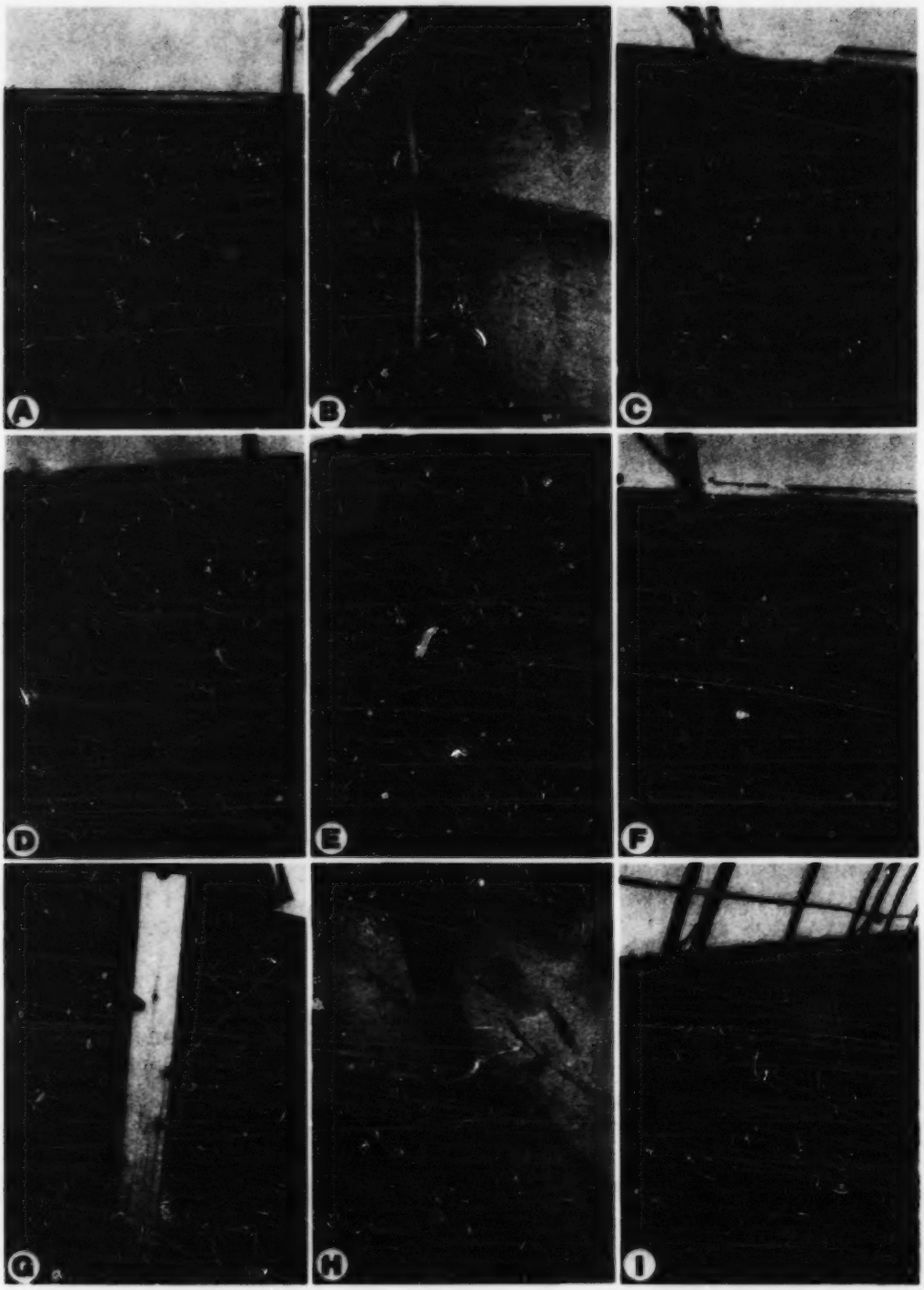
Endwall insulation is easily installed using EPS type 1 to fill the stud space. This material is less costly than EPS type 4 and is easily cut to conform to irregular stud cavity shapes. A vapour barrier must be applied, which can be covered with white-painted plywood to reflect light onto the crop surface.

Sidewall insulation is more complicated because of the frequent breaks wherever a reinforced truss is located. A step-by-step installation technique, developed at Acadia FES, is shown in Figure 1. By using poly-sheeting on the ends of the insulation, cheaper EPS type 1 provides the bulk of the insulation, while a thinner layer of the more expensive EPS type 4 acts as the vapour barrier on the inner side. Furring strips, 1 in. thick, nailed on top of the EPS type 1 insulation, separate it from the EPS type 4. Not only do these strips bring the inside layer of insulation out so it fits more readily over the unreinforced truss in the center, but the 1 in. airspace they create between the two layers adds extra insulation (about R 1). If the protective plywood sheathing is not required (in production facilities where the crops extend all the way to the sidewall and there is no walkway), the poly sheeting can be folded in and caulked in place behind the EPS type 4 layer. However, the exposed insulation must then be painted or it will degrade over time because of the U.V. component of sunlight.

PIPE INSULATION

The savings that can be realized by using pipe insulation will vary among nurseries, since most have different heating systems and pipe arrangements. In the past, pipe insulation had to be done professionally, but now a new product is available (Plasticorp. Ltd., Burlington, Ont.) which enables the nurseryman to apply his own insulation.

Figure 1. Sidewall insulation technique: (a) the bare sidewall sheathing; (b) a bead of caulking is run along the edge at each end close to the reinforced truss; (c) a short length of poly is pressed into the caulking; (d) EPS type 1 (2 in. thick) is placed into the wall cavity and 1 in. furring strips are nailed on top; (e) EPS type 4 (1 in. thick) is placed on top of the furring strips and two more beads of caulking are run on top of the insulation



close to the reinforced trusses; (f) the exposed edge of the poly is folded over the insulation and pressed into the caulking (g) a board is cut to fit along the top of the insulation; (h) the board is nailed and caulked into place, and; (i) a protective layer of plywood sheathing is applied and later painted white.

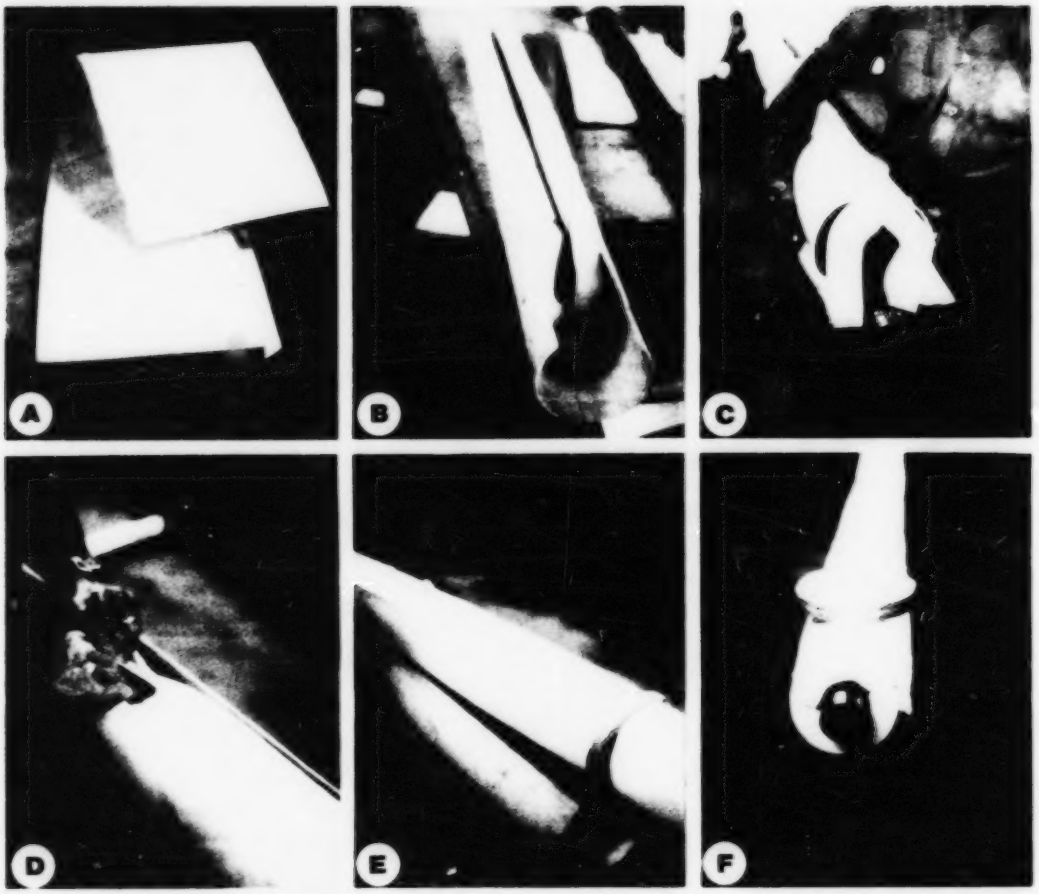


Figure 2. Pipe insulation: (a) a length of foam pipe insulation; (b) the insulation is folded into a jig made by cutting away a segment lengthwise from a piece of 6 in. diameter plastic pipe; (c) pipe plus jig are placed over a hot water pipe; (d) with the jig still in place the Velcro seam is sealed; (e) the seam is rotated and the jig removed, and; (f) the finished product, showing a plywood doughnut support which can be added if the pipe is to be placed within a rigid PVC plastic pipe sheath for below ground use.

The material is supplied in sheets of varying widths and thicknesses to accommodate different pipe diameters. The outside skin is a waterproof plastic with a Velcro seal along both edges. Using a simple jig made from a length of plastic pipe, the insulation can be applied in a one-man operation, even on previously installed pipe. The Velcro seal makes the insulation easily removable and reusable if, for instance, it must be stripped off to repair a leak. To prevent moisture from soaking into the insulation, it should be rotated after the Velcro is sealed so that the seam faces down. If both the supply and return lines of the unit heater are being insulated, thicker (higher R-value) insulation should be used on the supply side.

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